Examiner-Initiated Interview Summary	Application No.	Applicant(s)	
	09/588,407	BLACKMORE ET AL.	
	Examiner	Art Unit	
	Steven D. Maki	1733	

All Participants:

(1) *Steven D. Maki*.

(2) *David McEwing*.

Status of Application: _____

(3) _____.

(4) _____.

Date of Interview: *19 January 2006* and 1-20-06 and 1-24-06

Time: _____

Type of Interview:
- ☒ Telephonic
- ☐ Video Conference
- ☐ Personal (Copy given to: ☐ Applicant ☐ Applicant's representative)

Exhibit Shown or Demonstrated: ☐ Yes ☒ No
If Yes, provide a brief description:

Part I.

Rejection(s) discussed:
103

Claims discussed:
1-2,4-16,18-20,22-28

Prior art documents discussed:
art of record including Hollingsworth, Japan 334, Barton, Japan 161, Japan 323 and newly cited German 3525333

Part II.

SUBSTANCE OF INTERVIEW DESCRIBING THE GENERAL NATURE OF WHAT WAS DISCUSSED:
See Continuation Sheet

Part III.

☒ It is not necessary for applicant to provide a separate record of the substance of the interview, since the interview directly resulted in the allowance of the application. The examiner will provide a written summary of the substance of the interview in the Notice of Allowability.

☐ It is not necessary for applicant to provide a separate record of the substance of the interview, since the interview did not result in resolution of all issues. A brief summary by the examiner appears in Part II above.

Steven D Maki
(Examiner/SPE Signature)

_____
(Applicant/Applicant's Representative Signature – if appropriate)

Continuation of Substance of Interview including description of the general nature of what was discussed: On 1-19-06, Examiner informed applicant's representative that the prior art rejections using combination of Japan 334 and Hollingsworth have been withdrawn in view of the new arguments in the appeal brief filed 10-22-05. Examiner also informed applicant's representative that this application is not in condition for allowance and that prosecution will be reopened. On 1-19-06, examiner faxed German 3525333 and a translation for Japan 323 to applicant's representative. See Interview Summary Attachment A. Examiner noted that Japan 323 is directed to repairing pipes and that the heater tube comprises carbon fibers, which are used for resistive heating. Examiner noted that newly cited German 333 describes electrical resistive heating using carbon and graphite components in the form of fibers, cords, woven fabrics, yarns, strips and other forms. Examiner noted that German 333 describes incorporating the components in highly flexible materials. Examiner noted that German 333 describes the carbon or graphite components having advantages over conventional resistance heaters in mechanical stress capability. Examiner commented that the new rejection would be Barton in view of Japan 161 and Japan 323 / German 333; Barton teaching a device having an inflatable bladder for repairing conduit and heating to accelerate hardening of the resin; Japan 161 suggesting embedding a heating element for resistive heating in an expandable bladder to rapidly cure resin in lining material; Japan 323 / German 333 suggesting the use of carbon fibers for resistive heating. Examiner acknowledged that Japan 161 does not describe woven, but noted that Japan 334 describes a woven or knitted fabric for resistive heating. In order to expedite prosecution, examiner made the following proposal to place the case in condition for allowance: Cancel claims 1-2, 4-6 (non-appealed claims), cancel claims 7-11,23-25 (withdrawn claims), cancel claims 26-28 (these claims having 112 problems) and amend claims 12, 20 and 22 by inserting --comprising electrically conductive fibers-- after "heating element" and inserting --wherein the electrically conductive fibers are braided or arranged helically-- after "thermoset resin matrix". With respect to reasons for allowance, examiner commented that there is no motivation in the pipelining art to use braided or helically arranged carbon or graphite fibers disposed within the matrix of a bladder attached to the claimed end pieces in an apparaus for in-situ repair of a conduit. On 1-20-06, applicant's representative faxed proposed amended claims to the examiner. See Interview Summary Attachment B. On 1-24-06, discussed proposed amended claims. Examiner noted that --electrically conductive-- should be inserted before "fibers are braided" and that the claim identifier for claims 13, 15 and 16 should be --(original)--. .

Interview Summary Attachment A

attachment to paper no 011906

L1: Entry 1 of 2 File: EPAB Jan 29, 1987

PUB-NO: DE003525333A1
DOCUMENT-IDENTIFIER: DE 3525333 A1
TITLE: Electrical resistance heater having carbon and graphite components

PUBN-DATE: January 29, 1987

INVENTOR-INFORMATION:

NAME	COUNTRY
SEEMANN, EDGAR	DE
SEEMANN, BERND	DE

ASSIGNEE-INFORMATION:

NAME	COUNTRY
SEEMANN EDGAR	
SEEMANN BERND	

APPL-NO: DE03525333
APPL-DATE: July 16, 1985

PRIORITY-DATA: DE03525333A (July 16, 1985)

US-CL-CURRENT: 338/22R
INT-CL (IPC): H05B 3/14; H05B 3/34; H05B 3/54
EUR-CL (EPC): H05B003/14 ; H05B003/34

ABSTRACT:

CHG DATE=19990617 STATUS=O> The electrical resistance heater having carbon or graphite components operates with the current heat produced by the current flow in a resistive conductor material. In this case, the construction of the conductor materials is designed such that the carbon and/or graphite fibres consist of very thin individual threads. Said threads can be combined to any desired thickness and can also be matched to any conceivable shape. These fibre materials can be included in the processing in all known processing methods for producing fabric types. In this case, said fibre materials must be cohesively processed in order to ensure the electrical conductivity. Thus, however, these forms can also be used for sheathing objects requiring heat. These fibres be matched in a surface-insulated manner to any shape and position and, fed with electrical energy in series and/or parallel circuits, can be used as heat generators. The ability of the carbon and graphite to withstand specific environmental influences gives these components additional advantages. The simplicity of use and the versatility of applicability offer considerable advantages over conventional resistance heaters, above all in the field of mechanical stress capability as well.

attachment to paper no 011906

First Hit Previous Doc Next Doc Go to Doc#

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L1: Entry 2 of 2 File: DWPI Jan 29, 1987

DERWENT-ACC-NO: 1987-030094
DERWENT-WEEK: 198705

TITLE: Electrical resistance heating systems - with carbon and graphite components in various forms

INVENTOR: SEEMANN, B

PATENT-ASSIGNEE:

ASSIGNEE	CODE
SEEMANN E	SEEMI

PRIORITY-DATA: 1985DE-3525333 (July 16, 1985)

Search Selected Search ALL Clear

PATENT-FAMILY:

	PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
☐	DE 3525333 A	January 29, 1987		002	

APPLICATION-DATA:

PUB-NO	APPL-DATE	APPL-NO	DESCRIPTOR
DE 3525333A	July 16, 1985	1985DE-3525333	

INT-CL (IPC): H05B 3/14

ABSTRACTED-PUB-NO: DE 3525333A
BASIC-ABSTRACT:

In electrical resistance heating using carbon and graphite components in the form of fibres, cords, woven fabrics, yarns, strips and other forms (e.g. plates), the novel features are (i) the components can be used as constructional and finishing materials for architecture; (ii) the components can be applied to or incorporated in insulating materials; (iii) the components can be incorporated in fixed, mobile and even highly flexible materials; (iv) the components can act as energy and heat carriers independently of their form and location; (v) the components are independent of current type and frequency; (vi) the components can be stationary and mobile independently of form and location; and (vii) the components can be used universally for all applications in daily requirements.

ADVANTAGE - The resistance heating system is universally applicable, is simple to produce in any form and is simple to assemble and control compared with metallic resistance heating systems.

attachment to paper no 011906

CHOSEN-DRAWING: Dwg.0/0

TITLE-TERMS: ELECTRIC RESISTANCE HEAT SYSTEM CARBON GRAPHITE COMPONENT VARIOUS FORM

ADDL-INDEXING-TERMS:
CARBON@

DERWENT-CLASS: L03 X25

CPI-CODES: L02-H04; L03-A02B;

EPI-CODES: X25-B01B;

SECONDARY-ACC-NO:
CPI Secondary Accession Numbers: C1987-012785
Non-CPI Secondary Accession Numbers: N1987-022742

Previous Doc Next Doc Go to Doc#

attachment to paper no 011906

(19) BUNDESREPUBLIK DEUTSCHLAND

DEUTSCHES PATENTAMT

(12) **Offenlegungsschrift**

(11) **DE 3525333 A1**

(51) Int. Cl. 4:
H05B 3/14
H 05 B 3/34
H 05 B 3/54

(21) Aktenzeichen: P 35 25 333.9
(22) Anmeldetag: 16. 7. 85
(43) Offenlegungstag: 29. 1. 87

Behördeneigentum

DE 3525333 A1

(71) Anmelder:
Seemann, Edgar; Seemann, Bernd, 7460 Balingen, DE

(72) Erfinder:
gleich Anmelder

Prüfungsantrag gem. § 44 PatG ist gestellt

(54) Elektrische Widerstandsheizung mit Kohlenstoff- und Graphitbauelementen

Die elektrische Widerstandsheizung mit Kohlenstoff- und Graphitbauelementen arbeitet mit der Stromwärme, hervorgerufen durch den Stromfluß in einem widerstandsbehafteten Leiterwerkstoff. Dabei ist der Aufbau der Leiterwerkstoffe so gestaltet, daß die Kohlenstoff- oder/und Graphitfasern aus sehr dünnen einzelnen Fäden bestehen. Diese können in jeder beliebigen Dichte zusammengefaßt werden, wie auch jeder denkbaren Form angepaßt werden. In allen bekannten Verarbeitungsverfahren zur Herstellung von Gewebearten können diese Faserwerkstoffe mitverarbeitet werden. Dabei müssen diese zusammenhängend verarbeitet werden, um die elektrische Leitfähigkeit sicherzustellen. So können diese Formen aber auch zur Ummantelung von wärmebedürftigen Gegenständen genutzt werden. Oberflächenisoliert können diese Fasern jeder Form und Lage angepaßt, sowie in Reihen- oder/und Parallelschaltungen mit elektrischer Energie beschickt, als Wärmeerzeuger genutzt werden. Die Beständigkeit von Kohlenstoff und Graphit gegen bestimmte Umwelteinflüsse verleiht diesen Bauelementen zusätzliche Vorteile. Die Einfachheit der Anwendung und die Vielseitigkeit der Verwendbarkeit bieten erhebliche Vorteile gegenüber herkömmlichen Widerstandsheizungen, vor allem auch im Bereich mechanischer Belastbarkeit.

DE 3525333 A1

attachment to paper no 011906

Patentansprüche

Elektrische Widerstandsheizung mit Kohlenstoff- und Graphit-Bauelementen in Form von Fasern; Schnüren; Geweben; Garnen; Bändern; und anderen Formen; zum Beispiel Platten aus diesen Grundstoffen.

1. **dadurch gekennzeichnet,**: daß diese als Baustoffe und Veredlungsstoffe für die Raumgestaltung genutzt werden können.
2. dadurch gekennzeichnet,: daß diese an und in Isolierwerkstoffen verarbeitet werden können.
3. dadurch gekennzeichnet,: daß diese in feste und bewegliche, auch hochflexible Stoffe eingearbeitet werden können.
4. dadurch gekennzeichnet,: daß diese als Energie- und Wärmeträger unabhängig von Form und Lage arbeiten können.
5. dadurch gekennzeichnet,: daß diese von Stromart und Frequenz unabhängig sind.
6. dadurch gekennzeichnet,: daß diese unabhängig von Form und Lage stationär und mobil gestaltet werden können.
7. dadurch gekennzeichnet,: daß diese in allen Anwendungsbereichen des täglichen Bedarfs universell einsetzbar sind.

Beschreibung

Anwendungsgebiet:

Die Erfindung betrifft eine elektrische Widerstandsheizung aus Kohlenstoff- und Graphit-Bauelementen in Form von Fasern; Schnüren; Geweben; Garnen; Bändern und anderen Formen.

Zweck:

Die Erfindung bezweckt, die Einsatzmöglichkeit von Widerstandsheizungen mit elektr. Energie zu erweitern und ihren Aufbau, die Steuerung, Pflege und Wartung sowie Installation zu vereinfachen.

Stand der Technik:

Elektrische Widerstandsheizung mit herkömmlichen elektrischen Leitern sind bekannt. Sie sind durch die Verwendung von Metallen als Leiter nur bedingt verarbeitungsfähig und mechanisch beweglich herzustellen.

Kritik des Standes der Technik:

Beim Verarbeiten von Metallen mit anderen Werkstoffen entstehen häufig Probleme der Verträglichkeit. Insbesondere zerstören die Metalle durch abstehende oder abgebrochene Teile ihre Umhüllung. Das spezifische Gewicht von Metallen, die als Leiterwerkstoffe verwendet werden, liegt sehr hoch, so daß die Bausteine teilweise zu schwer für universellen Einsatz werden. Die Oxydation und Korrossion ist bei metallischen Leitern durch Umwelteinflüsse sehr groß.

Aufgabe:

Der Erfindung liegt die Aufgabe zugrunde, eine elektr. Widerstandsheizung zu schaffen, die einerseits ohne die unerwünschten Nebenwirkungen bekannter Systeme, mindestens die gleiche Wirkung erzielt, sowie bessere Einsatzmöglichkeiten, universellere Anwendung und vielseitigere Verwendbarkeit bietet.

Außerdem soll die Erfindung weitere Anwendungsgebiete erschließen, einfacheren Aufbau und Herstellung in beliebigen Formen ermöglichen, sowie leichtere Montage und Steuerung gewähren.

Lösung:

Die Aufgabe wird erfindungsgemäß dadurch gelöst, daß Kohlenstoff und Graphit als elektrischer Leiter in jeder Form und Größe aus feinsten einzelnen Fasern hergestellt werden kann. Ebenso können diese Werkstoffe in allen bekannten Verfahren als Gewebe hergestellt werden. Diese Formen können in allen bekannten elektrischen Schaltungsarten als Wärmeerzeuger eingesetzt werden.

Die dadurch erreichten Bauformen und Arten sind unabhängig von Form und Lage, stationär und mobil einsetzbar. Ihre Unempfindlichkeit gegen mechanische Einflüsse bietet die Vorteile neuer Einsatzgebiete und Anwendungsmöglichkeiten. Die weitere Verarbeitung aus sicherheits-technischen- und unfallverhütenden Gründen ist unproblematisch und somit leicht erreichbar. Auf Grund ihrer Einfachheit erschließen sich viele Möglichkeiten des Einsatzes auch unter schwierigen Bedingungen. Ihr Einsatz bei Wärmebedarf ist durch die vielseitige Verarbeitungsmöglichkeit der Bauelemente in allen bekannten Gebieten der Technik möglich. Die Nachteile bekannter, vergleichbarer Heizungsbausteine, sei es im Anwendungs- oder Installationsbereich, durch mangelnde mechanische, technische oder andere Eigenschaften werden durch die Verwendung der erfindungsgemäßen Bauelemente ausgeschaltet. Die Unabhängigkeit von Stromart und Frequenz gestalten die Steuerung und Regelung solcher Heizungselemente einfacher und kostensparender. Dabei entfällt auch der kostenintensive Aufwand bei nachträglichen Einbaumaßnahmen. Die Vorteile der erfindungsgemäßen Bauelemente liegen in der Breite des Anwendungsbereiches und in der Vielseitigkeit des Einsatzes sei es mobil oder stationär.

attachment to paper no 011906

Electrical resistance more heater having carbon and of graphites components

Description OF **DE3525333**

Description

Area of application: The invention concerns an electrical resistance heating from carbon and graphite elements in the form of fibers; Cords; Fabrics; Yarns; Volumes and other forms
Purpose: The invention aims at to extend the application type of resistance heatings with electricity and its structure, the control, to simplify servicing and maintenance as well as installation.

State of the art: Electrical resistance heating with conventional electrical conductors are admits you are to the use of metals as leaders only due processable and mechanically mobile to be manufactured.

Criticism of the state of the art: When processing metals with other materials frequently problems of the compatibility develop. In particular the metals destroy their casing by distant or broken off parts. The specific weight of metals, which are used as conductor materials, lies very highly, so that the components become partly too heavy for universal employment. The oxidation and Korrossion are very large with metallic leaders by environmental influences.

Task: The invention is the basis the task, one elektr, to create resistance heating on the one hand without the unwanted side effects well-known systems, at least the same effect obtained, as well as better application type, more universal application and more versatile usefulness offers.

In addition the invention is to open further areas of application, to make simpler structure and production possible in arbitrary forms, as well as to grant easier assembly and control.

Solution: The task is solved according to invention by the fact that carbon and graphite can be made as electrical conductors in each form and size of finest individual fibers. Likewise these materials in all well-known procedures can be manufactured as fabrics. These forms can be used in all well-known electrical switching types as boilers.

The designs and kinds reached by it are independently of form and situation, stationarily and mobilely applicable. Their insensitivity to mechanical influences offers the advantages of new operational areas and application possibilities. The further processing from safety-relevant and accident-preventing reasons is unproblematic and thus easily attainable. Due to their simplicity many possibilities of the employment are opened also under difficult conditions. Their employment with heat requirement is possible by the versatile processing possibility of the elements in all well-known fields of the technology. The disadvantages of well-known, comparable heating engineering stones, it is oderInstallationsbereich in application, by mechanical lacking, technical or other characteristics by the use of the elements according to invention is switched off. The independence from type of current and frequency arrange the control and regulation of such heater elements simpler and more cost-saving. Also the cost-intensive expenditure is void with additional installation dimension-taken. The advantages of the elements according to invention are in the width of the range of application and in the versatility of the employment are mobile or stationary it.

attachment to paper no 011906

Electrical resistance more heater having carbon and of graphites components

Claims OF **DE3525333**

Patent claims
Electrical resistance heating with carbon and graphite elements in the form of fibers; Cords; Fabrics; Yarns; Volumes; and ande ren forms; for example plates from these Raw materials.

1. by it,: that this as Baustof fe and improving material for the spatial arrangement can be used.

2. by it characterized,: that these to and in
Insulation materials to be processed can.

3. by it characterized,: that these can be trained in firm and mobile, also highly flexible materials.

4. by it characterized,: that these can work as energy and heat distribution media independently of form and situation.

5. by it characterized,: that these of type of current and frequency are independent.

6. by it characterized,: that these can be arranged independently of form and situation stationary and mobile.

7. by it characterized,: that these are sell applicable in all at idiom ranges of the daily need.

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attachment to paper no 011906

PTO 05-5433

Japanese Kokai Patent Application
No. Hei 2[1990]-158323

HEATER TUBE & METHOD FOR REPAIRING CONDUIT

Mamiko Endo

UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. AUGUST 2005
TRANSLATED BY THE MCELROY TRANSLATION COMPANY

attachment to paper no 011906 1

JAPANESE PATENT OFFICE
PATENT JOURNAL (A)
KOKAI PATENT APPLICATION NO. HEI 2[1990]-158323

Int. Cl.[5]:	B 29 C 63/36 //B 32 B 1/08 B 29 K 101:10 105:08 B 29 L 23:22
Sequence Nos. for Office Use:	7729-4F 6617-4F
Filing No.:	Sho 63[1998]-312916
Filing Date:	December 13, 1988
Publication Date:	June 18, 1990
No. of Claims:	2 (Total of 8 pages)
Examination Request:	Not filed

HEATER TUBE & METHOD FOR REPAIRING A CONDUIT
[Hita chubu oyobi kanro hoshu hoho]

Inventor:	Mamiko Endo
Applicant:	Mamiko Endo
Agent:	Junichi Yamashita

[There are no amendments to this patent.]

Claims

1. A heater tube characterized by the fact that it is composed by attaching two or more conductors of higher conductivity than that of a flexible tubular member having conductivity in the longitudinal direction of this tubular member.

2. A method for repairing a conduit characterized by the fact that after or concurrent to inserting a tube lining material composed by impregnating a thermosetting resin in a resin absorbent, the heater tube according to Claim 1 is internally inserted inside said tube lining

material, the aforementioned conductor of the heater tube is conducted while pressing said heater tube and tube lining material to the inner circumferential surface of the conduit according to fluid pressure, and then, the heater tube is removed from the conduit.

Detailed description of the invention

Industrial application field

The present invention relates to a method for repairing a conduit, which applies a lining to the inner circumferential surface of a worn out conduit and repairs this worn out conduit and a heater tube used in this method.

Prior art

A method for repairing a conduit, which applies a lining on the inner circumferential surface without digging out the conduit and repairs, reinforces, etc. the worn out conduit, when sewage, electric, gas pipes, and other industrial conduits wear out, has already been proposed and provided for practical application (eg., refer to Kokai Patent Application No. Sho 60[1985]-242038). Namely, this method for repairing conduit is a method which inverts and inserts a tube lining material composed by impregnating a setting resin in a flexible resin absorbent wherein the surface thereof has be film coated into a worn out conduit according to fluid pressure, presses this to the inner circumferential surface of the worn out conduit, heats the tube lining material to set the setting resin impregnated therein, and applies a lining by forming a rigid internal wall lining tube on the internal surface of the worn out conduit.

Problems to be solved by the invention

When a thermosetting resin was used as the setting resin impregnated in the aforementioned tube lining material used in the aforementioned method, there were problems such as requiring great thermal energy and a lot of time for heating since this thermosetting resin was heated indirectly with a fluid such as water, air, etc. as the heat medium, and the work efficiency and the workability were poor.

Also, when in particular the thickness of the tube lining material was thick, there was the problem of a large temperature difference being created between the inner circumferential part that makes contact with the heat medium and the outer circumferential part that makes contact with the inner circumferential surface of the conduit, thermal deformation occurring in the tube lining material originating from said temperature difference, and in the worst case, cracks being created.

attachment to paper no 011906

The present invention was reached by giving consideration to the aforementioned problems and the purpose thereof is to provide a heater tube that heats the thermosetting resin impregnated in the tube lining material uniformly and instantaneously with minimal energy.

Also, the purpose of the present invention is to provide a method for repairing a conduit capable of achieving improvement in the work efficiency and workability, minimizing costs, etc. by using the aforementioned heater tube.

Means to solve the problems

In order to achieve the aforementioned purpose, the present invention constituted a heater tube by attaching two or more conductors of higher conductivity than that of a flexible tubular member having conductivity in the longitudinal direction of this tubular member.

Also, the method of repairing a conduit related to the present invention is characterized by the fact that after or during inserting a tube lining material composed by impregnating a thermosetting resin in a resin absorbent, the heater tube according to Claim 1 is inserted inside said tube lining material, the aforementioned conductors of the heater tube are conducted while pressing said heater tube and tube lining material to the inner circumferential surface of the conduit according to fluid pressure, and then, the heater tube is removed from the conduit.

Operation of the invention

By conducting the conductors of the heater tube while pressing the heater tube and the tube lining material against the inner circumferential surface of the conduit according to fluid pressure as described above, the current flows in the circumferential direction of the tubular member from one conductor and reaches the other conductor and the tubular member as the electric resistor heats, hence the heater tube is heated uniformly over the entire circumference and length, the thermosetting resin impregnated in the tube lining material positioned on the outer circumferential side thereof is heated, and the thermosetting resin is set uniformly and instantaneously. By removing the heater tube from the conduit thereafter, the inner circumferential surface of the conduit is lined with the tube lining material that has set, the repair efficiency becomes favorable, and inconveniences such as cracks being created in the set tubular lining material, etc. are not generated. Incidentally, the heater tube that was removed can be reused in the following conduit repair work.

Also, according to the present invention, a heater tube is heated just by conducting the conductors of the heater tube, hence numerous heating mediums for heating the thermosetting resin become unnecessary, and miniaturization and energy savings of the heating equipment can be achieved, and the costs necessary for the repair work can be decreased.

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Embodiments of the invention

Below, working examples of the present invention will be described based on the figures.

Figure 1 is an oblique view of heater tube (1) related to the present invention. This heater tube (1) is composed by attaching two copper wires (3) and (3) with a higher conductivity than that of flexible tubular member (2) having conductivity in the longitudinal direction of flexible tubular member (2), the outer circumferential surface of tubular member (2) is coated with film (4) such as urethane, polyester, elastomer, silicon, etc., which has a air tightness, water tightness, and electrical insulation property. Incidentally, for example, a non-woven fabric composed by mixing carbon fibers in a felt material made of polyester is used as tubular member (2).

Next, conduit repair work, which is carried out using aforementioned heater tube (1) will be described based on Figures 2-5. Incidentally, Figure 4 is a cross sectional view along line IV-IV in Figure 3.

To repair branch tube (6) that branches from main tube (5), elbow (9) is supported according to arm (8), which is attached to the tip part of carrier (7) arranged within main tube (5) and tube lining material (10) is passed through this elbow (9) together with heater tube (1) as shown in Figure 2. Heater tube (1) is positioned on the inside of tube lining material (10) and these compose the inside and outside double layer. Incidentally, tube lining material (10) is composed by impregnating a thermosetting resin in a felt material such as polyester, etc.

And then, one end of aforementioned heater tube (1) and tube lining material (10) are turned inside out, and attached to the upper circumferential edge of aforementioned elbow (9); one end of tube (11) is attached to the other end of elbow (9), and the other end of tube (11) is closed with disk shaped lid (12). Compressed air supply pipe (13) that opens into space (S) formed within tube (11), pressure gage (14), and pressure regulating valve (15) are attached to this lid (12). Hose (17) that leads out from the discharge side of air compressor (16) is connected to pipe (13). Also, two copper wires (3) and (3) lead out from heater tube (1) extend to the outside of space (S) penetrating lid (12) and are connected to power source (18), which is installed above the ground. Also, temperature sensor (19) such as a thermocouple, etc. is embedded within heater tube (1), lead line (20) leading out from this temperature sensor (19) is connected to temperature controller (21) similarly installed above the ground, and this temperature controller (21) is connected electrically to aforementioned power source (18). Incidentally, power source (18) can be either AC or DC.

By driving air compressor (16) and supplying the compressed air discharged from air compressor (16) into space (S) via hose (17) and pipe (13), heater tube (1) and tube lining material (10) receive the pressure of this compressed air and are inverted and inserted into branch tube (6).

When inversion and insertion of aforementioned heater tube (1) and tube lining material (10) are completed to span the entire length of branch tube (6) as shown in Figure 3, power source (18) is turned ON while maintaining the internal pressure of space (S) at a predetermined value and copper wires (3) and (3) of heater tube (1) are conductive. Then, the current flows in the circumferential direction of tubular member (2) from one copper wire (3) and reaches other copper wire (3) in a state wherein heater tube (1) and tube lining material (10) are pressed to the inner circumferential wall of branch tube (6), tubular member (2) as an electrical resistor is heated uniformly over the entire circumference and entire length, and the thermosetting resin impregnated in tube lining material (10) is set uniformly and instantaneously by being heated directly, hence the conduit repair work progresses efficiently and the inner circumferential surface of branch tube (6) is lined with tube lining material (10) that has set. Incidentally, the temperature of heater tube (1) is detected with temperature sensor (19), temperature controller (21) controls the current supplied by power source (18) based on this detected temperature, and the temperature of heater tube (1) is maintained at a fixed temperature.

Also, the thermosetting resin impregnated in tube lining material (10) sets quickly as was described above, hence heat deformation is not generated and inconveniences are not created such as cracks being generated in tube lining material (10) after the setting, etc.

Furthermore, many heat mediums for heating the thermosetting resin are not necessary when heater tube (1) related to the present invention is used, hence the heating equipment is small and compact, the consumed energy is minimal, and the costs required for the repair work can be decreased.

And then, by removing heater tube (1) from tube lining material (10) and cutting off the unnecessary part of tube lining material (10), branch tube (6) is lined with tube lining material (10) that has set as shown in Figure 5 and the repair work is completed. Incidentally, heater tube (1) that was removed can be used repeatedly.

Next, another method for repairing conduit, which is carried out using heater tube (1) will be described based on Figures 6 and 7. In Figure 6 and Figure 7, the same elements as those shown in Figures 2-5 are noted with the same reference numbers and description of these elements is omitted below.

In this repair method, first, only tube lining material (10) is drawn into branch tube (6) as show in Figure 6 and this is attached to fixed stand (22) installed above the ground via ropes (23) and (23)

Next, one end part of heater tube (1) is passed through casing (24) supported at the center of aforementioned fixed stand (22) and this end part is turned inside out and fixed to the outer circumference at the bottom end opening part of casing (24). Incidentally, the section of heater tube (1) inserted into casing (24) is sealed airtight with valve (25).

By feeding compressed air into casing (24) from air compressor (16) as described above, heater tube (1) receives the pressure of this compressed air and inverts successively. And then, when inversion of heater tube (1) is completed for the entire length of branch tube (6) as shown in Figure 7, power source (18) is connected to copper wires (3) and (3) of heater tube (1) while maintaining the internal pressure of space (S) surrounded by casing (24) and inverted heater tube (1) at a fixed pressure.

And then, heater tube (1) is heated uniformly like in the aforementioned working example and the thermosetting resin impregnated in tube lining material (10) heats and sets quickly, hence the same effects as those obtained in the aforementioned working example are obtained. By pulling rope (26) tied to the end part of inverted heater tube (1) and removing from tube lining material (10) after tube lining material (10) has set, this heater tube (1) can be reused.

Incidentally, in the aforementioned working examples, a case of using the heater tube related to the present invention for repairing, in particular, a branch tube, was described. However, this heater tube can also be used for repairing the main tube.

Effect of the invention

As apparent from the description above, according to the present invention, a heater tube is heated by conducting the conductors in the heater tube and the thermosetting resin impregnated in the tube lining material is directly heated and set quickly according to this heater tube, hence there are effects such as being able to achieve improvement in the efficiency and workability in conduit repair work, minimize cost, etc.

Brief description of the figures

Figure 1 is an oblique view of a heater tube related to the present invention, Figures 2-5 are cross-sectional views showing the method in the present invention, Figure 4 is a cross-sectional view along line IV-IV in Figure 3, an Figure 6 and Figure 7 are cross-sectional views showing another working example of the method in the present invention.

(1)...heater tube, (2)...tubular member, (3)...copper wire (conductor), (10)...tube lining material, (16)...air compressor, (18)...power source.

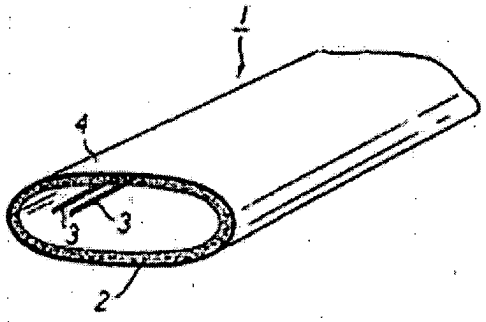

Figure 1

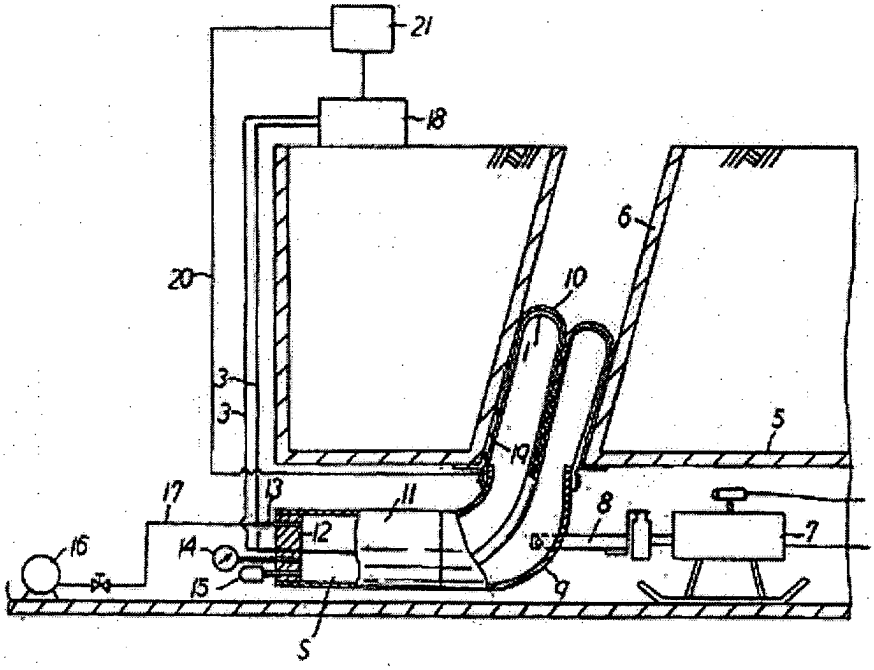

Figure 2

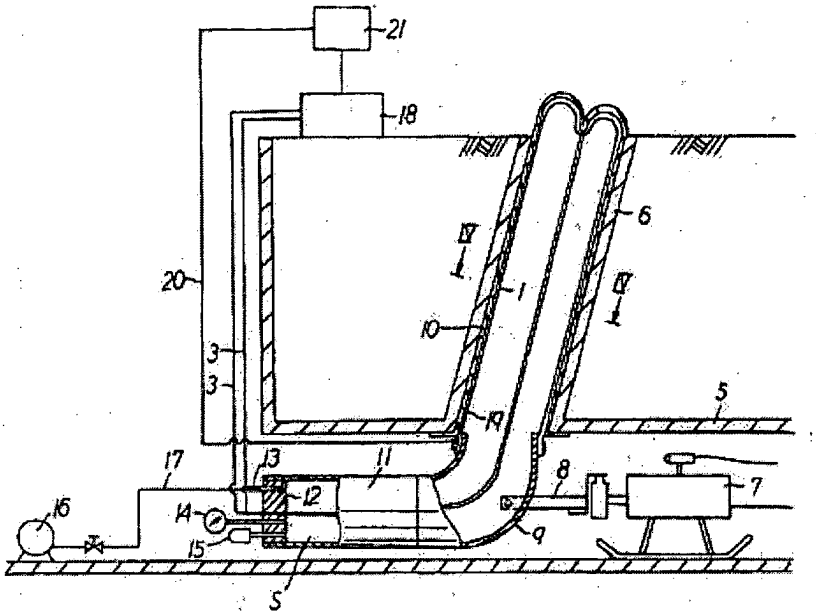

Figure 3

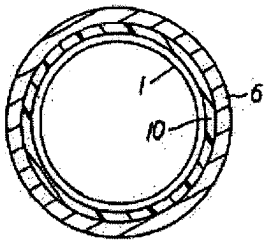

Figure 4

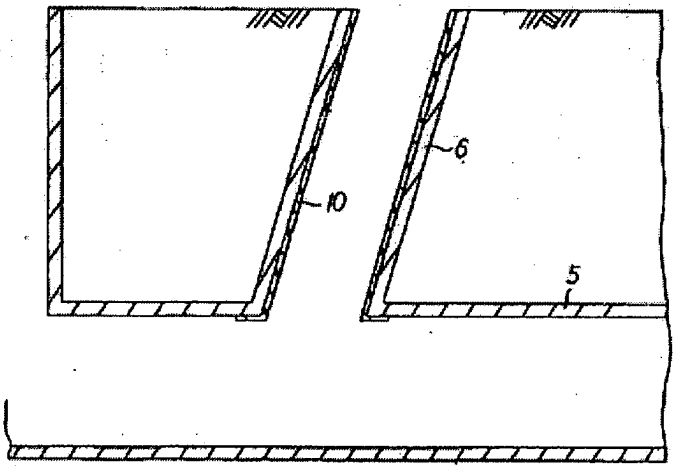

Figure 5

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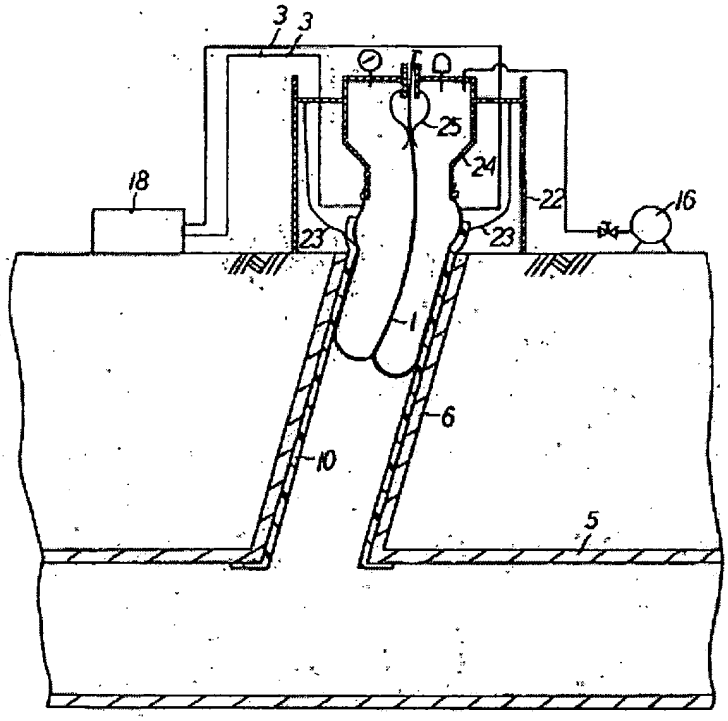

Figure 6

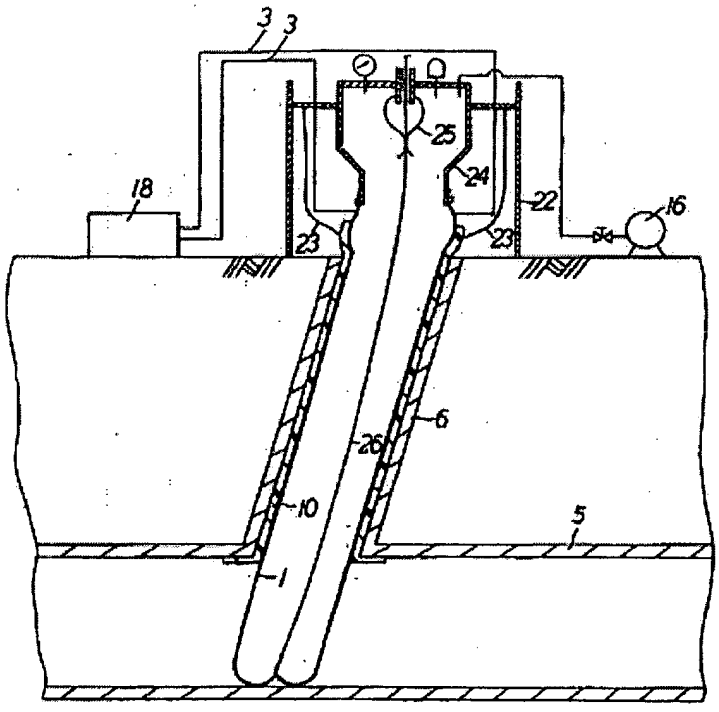

Figure 7

Interview Summary Attachment B

attachment to paper no 011906

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Number of Pages (including cover) 4

DATE: January 20, 2006

RE: Proposed amended claims

COMMENTS: I believe all of your changes have been adopted.

attachment to paper no 011906

FOR DISCUSSION PURPOSES

January 20, 2006

Claims 1-11 (Cancelled)

12. (Currently Amended) An apparatus for curing a pre-preg repair material supporting a heat curable resin for in-situ repair of a conduit, comprising:

an elastomeric composite having a first end and a second end, wherein the composite includes a non-ferrous heating element comprising electrically conductive fibers comprised of carbon fibers, graphite fibers, carbon filaments or graphite filaments and disposed within a thermoset resin matrix wherein the fibers are braided or arranged helically;

a first end piece fixedly attached to the first end of the composite and having an air port for communication with a compressed air source, a vacuum port for communication with a vacuum supply source and at least one electrical cable port to convey electric current to the non-ferrous heating element from a power supply source; and

a second end piece fixedly attached to the second end of the composite, wherein the composite, the first end piece, and the second end piece form a generally hollow inflation chamber.

13. (Previously Presented) The apparatus of Claim 12 wherein the thermoset resin is selected from the group consisting of fluorocarbon and fluorosilicone.

14. (Previously Presented) The apparatus of Claim 12 wherein the heating element includes a plurality of braided fibers comprising temperature tolerant fiber braids and electrically conductive fiber braids.

15. (Previously Presented) The apparatus of Claim 14 wherein the braided fibers interact to define a braid angle measure at +/- 45 degrees.

16. (Previously Presented) The apparatus of Claim 14 wherein the electrically conductive fiber braids are carbon filaments.

Claim 17 (Cancelled)

18. (Previously Presented and Allowed) An apparatus for curing a pre-preg repair material supporting a heat curable resin for in-situ repair of a conduit, comprising:

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an elastomeric composite having a first end and a second end, wherein the composite includes a non-ferrous heating element comprised of a plurality of filament wound carbon fibers, filament wound graphite fibers, filament wound carbon filaments or filament wound graphite filaments and disposed within a thermoset resin matrix;

a first end piece fixedly attached to the first end of the composite and having an air port for communication with a compressed air source, a vacuum port for communication with a vacuum supply source and at least one electrical cable port to convey electric current to the non-ferrous heating element from a power supply source; and

a second end piece fixedly attached to the second end of the composite, wherein the composite, the first end piece, and the second end piece form a generally hollow inflation chamber.

19. (Previously Presented and Allowed) The apparatus of Claim 18 wherein the wound fibers interact to define an angle measure at +/- 45 degrees.

20. (Currently Amended) A method for repairing a damaged section of a conduit comprising the steps of:

providing an elastomeric composite having a first and second end, wherein the composite includes a non-ferrous electrically conductive heating element comprising electrically conductive fibers comprising carbon fibers, graphite fibers, carbon filaments or graphite filaments and disposed within a thermoset resin matrix wherein the fibers are braided or arranged helically;

fixedly attaching a first and second end piece respectively to the first and second ends of the composite, wherein the first end piece, the second end piece, and the composite form a heating/inflation module;

removably attaching a pre-preg to an outer surface of the composite, wherein the pre-preg includes a structural fiber matrix supporting a heat curable resin;

positioning the module with the attached pre-preg into the conduit at a damaged location;

inflating the module to a predetermined internal air pressure to expand the

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composite and press the pre-preg against an inside surface of the conduit;

curing the resin of the pre-preg by causing an electrical current to flow in the heating element to resistively heat the module to a predetermined temperature; and

deflating the module and removing it from the conduit.

Claim 21 (Cancelled)

22. (Currently Amended) A system for in-situ repair of a conduit, comprising:

an apparatus including an elastomeric composite having a first end and a second end, wherein the composite includes a non-ferrous heating element comprising electrically conductive fibers comprising carbon fibers, graphite fibers, carbon filaments or graphite filaments and disposed within a thermoset resin matrix wherein the fibers are braided or arranged helically;

a first end piece fixedly attached to the first end of the composite and having an air port for communication with a compressed air source, a vacuum port for communication with a vacuum supply source and at least one electrical cable port to convey electric current to the non-ferrous heating element from a power supply source;

a second end piece fixedly attached to the second end of the composite, wherein the composite, the first end piece. and the second end piece form an inflation chamber; and,

a pre-preg removably attached to an outer surface of the composite of the apparatus, the pre-preg including a structural fiber matrix supporting a heat curable resin.

Claims 23-52 (Cancelled)